TEACHING AND LEARNING MATHEMATICS USING MOODLE

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Abstract

This paper summarizes a project that is contributing to a change in the way of teaching and learning Mathematics.
Mathematics is a subject of the Accounting and Administration course. In this subject we teach: Functions and Algebra. The aim is that the student understand the basic concepts and is able to apply them in other issues, when possible, establishing a bridge between the issues that they have studied and their application in Accounting.
As from this year, the Accounting course falls under in Bologna Process. The teacher and the student roles have changed. The time for theoretical and practical classes has been reduced, so it was necessary to modify the way of teaching and learning.
In the theoretical classes we use systems of multimedia projection to present the concepts, and in the practical classes we solve exercises. We also use the Excel and the mathematical open source software wxMaxima.
To supplement our theoretical and practical classes we have developed a project called MatActiva based on the Moodle platform offered by PAOL - Projecto de Apoio Online (Online Support Project).
With the creation of this new project we wanted to take advantage already obtained results with the previous experiences, giving to the students opportunities to complement their study in Mathematics. One of the great objectives is to motivate students, encourage them to overcome theirs difficulties through an auto-study giving them more confidence.
In the MatActiva project the students have a big collection of information about the way of the subject works, which includes the objectives, the program, recommended bibliography, evaluation method and summaries. It works as material support for the practical and theoretical classes, the slides of the theoretical classes are available, the sheets with exercises for the students to do in the classroom and complementary exercises, as well as the exams of previous years. Students can also do diagnostic tests and evaluation tests online.
Our approach is a reflexive one, based on the professional experience of the teachers that explore and incorporate new tools of Moodle with their students and coordinate the project MatActiva.

Keywords
Mathematics, Moodle, projects and innovations, research in education, technology in education.

1. INTRODUCTION

The Institute of Accounting and Administration of Oporto (ISCAP) belongs to one of Portugal's largest and most prestigious public Polytechnic Institutes, the Polytechnic Institute of Oporto (IPP). ISCAP has 238 teachers and it offers its 4,000-strong student population a range of innovative graduate programs in Accounting and Administration, International Commerce, Marketing, Business Communication, and Administrative Assistance and Translation. The Accounting course is the one that has a larger number of students.
Several public and private schools in the region also offer some of these courses. One of the means of ISCAP to compete with these schools and impose itself in the higher Portuguese education, is offering a captivating education, adapted to the needs of students and to the new challenges related in the Bologna Process.
In order to answer to new challenges, the ISCAP started in 2003 the Online Support Project (PAOL) offering pedagogical and technical support to all teachers and students to make possible supplementary means for the presential subjects/classes, allowing the student greater facility of

access to the materials for study and the communication activities of student-teacher and student-student.
In the beginning the e-learning platform used was WebCT but in 2005 it was changed to the platform Moodle (Modular Object-Oriented Dynamic Learning Environment). Moodle is an Open Source course management system centered around learners' needs and designed to support collaborative approaches to teaching and learning. Philosophically based on social constructionist pedagogy, Moodle has been and continues to be developed on a grassroots level, with new versions regularly released to the user community. Moodle offers users a rich interface, context-specific help buttons, and a wide variety of tools such as discussion forums, wikis, chat, surveys, quizzes, glossaries, journals, grade books and more, that allow them to learn and collaborate in a truly interactive space.
The number of PAOL users has been growing quite well as the number of areas involved and the type of activities that are offered became more complex. In part this is because the teachers have more knowledge about the platform, largely due to the training that has been provided by the PAOL, but also to their research and personal dedication.
In May 2006, 60% of the students and 30% of the teachers used the PAOL. Until then we could check that the scientific area of Mathematics was used the PAOL almost exclusively as a repository of information, where teachers put theoretical materials and exercises sheets as support of practical subjects/classes. The forums, chats or other activities were almost non-existent.
On the other hand, we all know that Mathematics is an essential component of the educational system. The teaching and learning of mathematics at the tertiary level is a matter of concern in almost all countries. Universities and Polytechnic Institutes face increasing difficulties at enrolling students in university studies in which mathematics is a substantial component and teachers face increasing difficulties at helping their students learn the mathematics they would like them to learn. It was thinking in overcoming these difficulties that we in 2006/2007 developed a project called Matemática Activa no ISCAP (Active Mathematics in ISCAP) based on the Moodle platform. So MatActiva arose as a need to improve learning and levels of success in the subjects of the area of Mathematics in Accounting course.

2. OBJECTIVES

With the creation of this new project we wanted to take advantage of the already obtained results with the previous experiences, giving the students opportunities to complement their study in Mathematics.
The main objective of this project was to innovate the teaching and learning process exploring technologies as a pedagogical resource and to induce bigger motivation to the students, improve the rate of success rates and make available to students a set of materials adapted to their needs. This concern is justified due to the fact that students have a weak preparation without consolidated basis.
One of the great objectives is to motivate students, encourage them to overcome their difficulties through a self-study giving them more confidence.
The pedagogical innovation and flexibility temporal supporting the individual and collaborative study of students, has been of great importance especially for the working students who can not always attend classes and timely access to the support materials. The aim is not to replace the classroom presence but a complement to these.
The specific objectives underlying the elaboration of this project were to create a secure repository for documents, providing support material, promote self-learning, increase the self-confidence of students, increase the communication between students and teachers and between students.

3. THE LEARNING AND TEACHING PROCESS

Several studies point to the need to develop teaching strategies that address the various styles of learning (Skalnik et al. In Gunkel (1996) - as quoted by Reid (1996)). There is a need to create curriculum materials that increase the confidence of students, making them responsible for their own education and learning. In this model, teachers act as facilitators, guiding the students instead of imposing subjects. In particular, in our school we give a special emphasis to the connection of mathematics with economics.
The perspective values and aims of our students have changed. We as mathematics educators working at tertiary level, need to destroy some myths, practices and considerations by taking some positive steps towards another way of teaching. There are some changes to be considered and some

goals for our future as mathematics teachers, it is time for us to make some crucial changes in mathematics education. So it's time for action.
The new paradigm is based on a model that requires new skills and new teaching practices. The teachers must develop methodologies more dynamic and centralized in the student. Meanwhile to the student is require a greater involvement in the choice of his school journey, greater responsibility and commitment in the teaching / learning process. That's why changes are needed at the level of the objectives and methods of teaching / learning and even the evaluation.
This year, with the implementation of the Bologna Process in the Accounting course, we feel a great need to provide other types of activities to students. The time for theoretical and practical subjects/classes has been reduced, so it was necessary to modify the way of teaching and learning. In the theoretical and practical classes we follow the programme with elucidative examples through PowerPoint slides.
On the page of the subject in PAOL, students have the slides and exercises for subjects/classes, as well as sheets of supplementary exercises. All these resources are available in pdf format, in general, a week before being taught in class.
We have followed a strategy that makes the project compatible with the theoretical and practical subjects/classes, complementing them. So on the page of the MatActiva we can find other types of resources: diagnostic tests, multiple-choice tests, an area of doubt, an area of humour and links to pages about mathematics.
We would like to bring back with MatActiva the spirit that is necessary to defend the need of producing good teaching materials.
To build this project we took into consideration what technology can and must do in mathematics instruction and for that we follow the John Keller's [5] ARCS model, that defends proper instruction must implement:

- Attention - the instruction must capture students' attention.
- Relevance - the student must find the materials relevant to him or her.
- Confidence - the instruction must develop students' confidence in their own capabilities.
- Satisfaction - in the end of the educational event, the student must get satisfaction from knowing that he or she has mastered the required content.

Now we will describe how the project MatActiva has been implemented in The Institute of Accounting and Administration of Oporto (ISCAP).

4. ORGANIZATION AND IMPLEMENTATION

A group of 6 of mathematics teachers, of which we are part, developed the project MatActiva and since then have worked with the sole motivation of improving the mathematical knowledge of our students and the relationship they have with mathematics.
The organization and implementation followed by an approach by chapters of the subjects treated in the classes.
We have been concerned in creating a project of simple access, intuitive and with a set of useful functionalities according to the subjects taught in mathematics.
In figure 1 we can observe the initial menu with 6 topics.

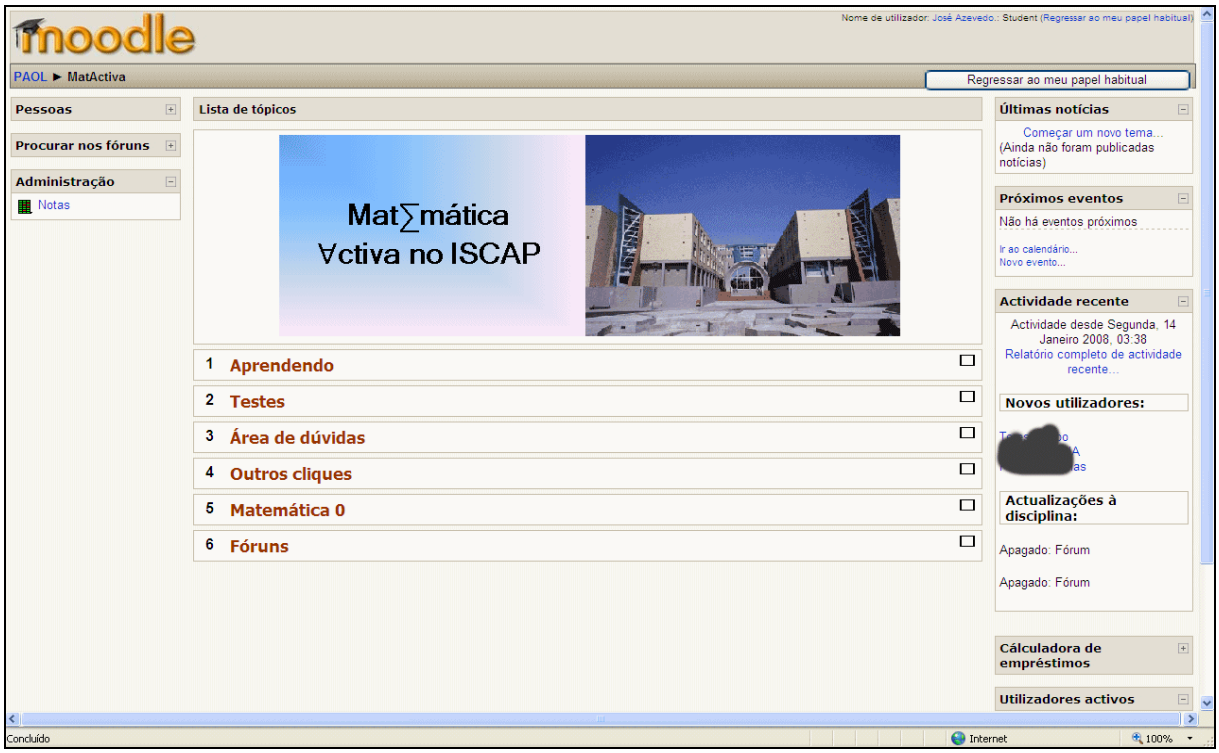

Fig.1. Initial menu

- Learning – In this topic students can find guide lessons about subjects related with the program of mathematics and find great math formulas resources and math tables.

- Tests – At this point the students can find and solve online diagnostic tests, evaluation tests with multiple choice or true / false questions. We have created a large bank of questions that originated a series of self-evaluation tests, which the student can solve and submit, taking conscience of their level of knowledge.

- Area of Doubts – Here the students can put their doubts online and there is a teacher that gives online answers.

- Other Clicks – We can find here some mathematics jokes and curiosities, so that students can relax a little and enjoy mathematics and see how mathematics are amazing; other links to others interesting math pages.

- Mathematics Zero – An area that serves as support for the students who have difficulties and deficiencies in basic mathematics. The students that are in the Mathematics Zero have access to support documents to the subjects/classes of this course.

- Forums - Leave Your Opinion – where the students can leave their opinions about MatActiva and give suggestions to improve the project.

We can see all this topics in figure 2.

Fig.2. Initial menu expanded

Figure 3 is an example of a multiple choice test.

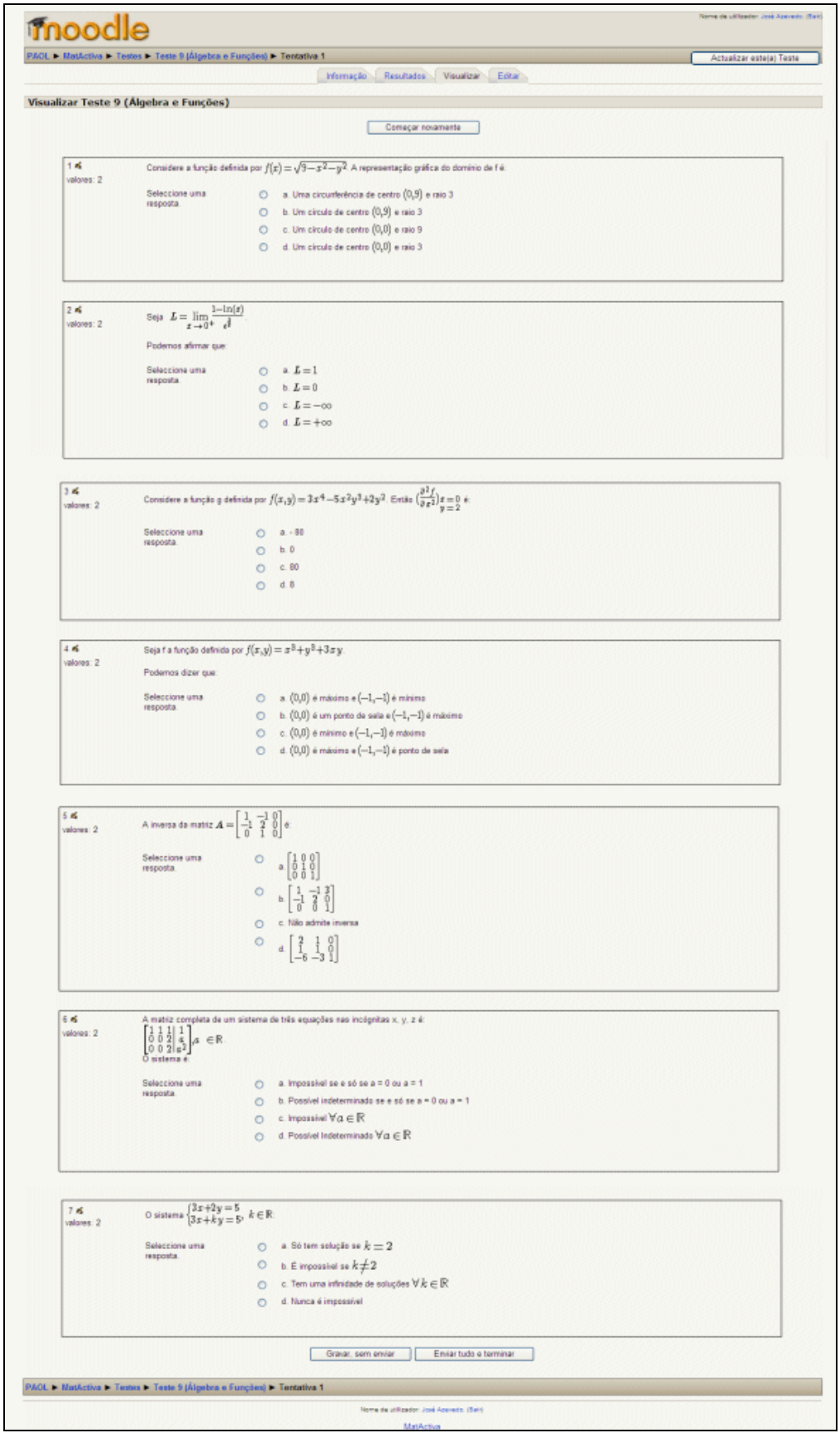

Fig.3. Example of a multiple choice test

Figure 4 is an example of an exercise in a test of self-evaluation.

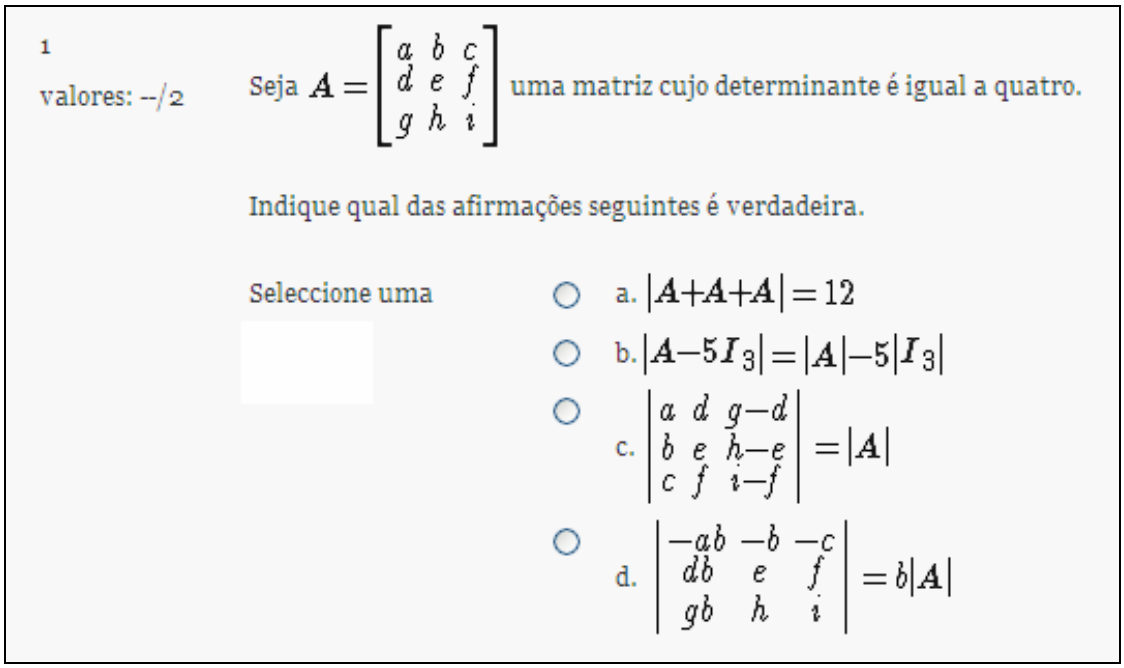

Fig.4. Question in a test of self-evaluation

The fact that this project is of mathematics requires a great effort from the submission of written text. One of the greatest difficulties we feel when we were doing the tests was the writing of the questions and answers using the language TeX.
According to some people, there are programs that facilitate the conversion of mathematical text to TeX directly without the need to use the command of this language but which are not yet being implemented in the version of Moodle used in ISCAP. Furthermore, our project is hosted on a recent version of the Moodle (only used by some teachers that will explore this version and solve the problems as they come).

In figure 5 is visible that we need a long time to generate the required language to write the multiple-choice answers using TEX.

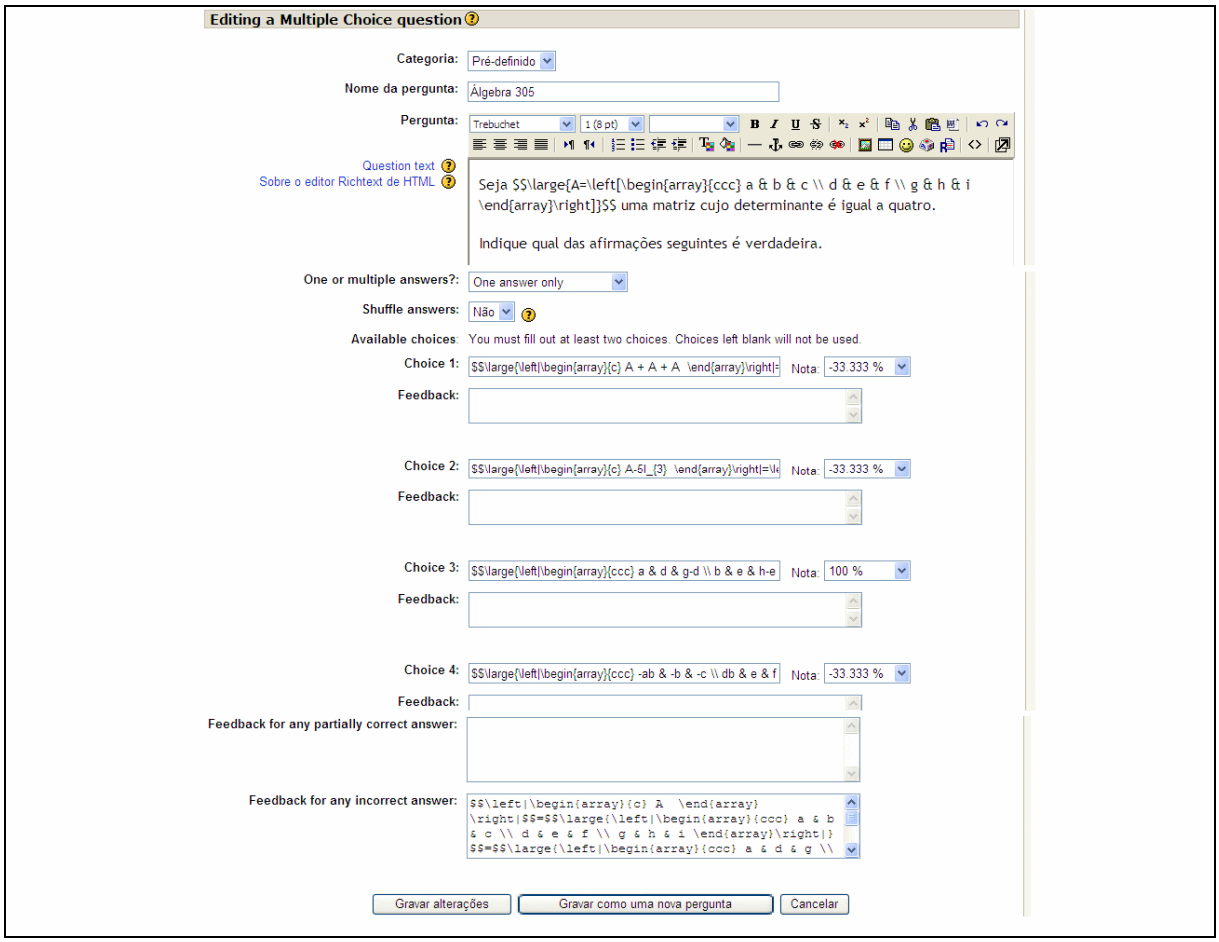

Fig.5. Edition a question with Latex

5. RESULTS

The acception of the students has been excellent. It was possible to verify that one or two weeks before the exams there was an increasing number of registrations. The students are always asking for more material. The area used more often by the students is that of multiple-choice tests, perhaps because it is one way to prepare them to the exams and a knowledge test. The number of students who access the page grows every day and it encourages us to continue with this project.
The only unfavourable point is the fact that this whole project was developed only a small number of the teachers of the subject of Mathematics. This is a hard work for a few people.

6. CONCLUSION AND FUTURE WORK

One of the great objectives of this project was to motivate students, encourage them to overcome their difficulties through a self-study giving them more confidence.
In this project the students were able to access the material to support of their study in the subject of mathematics, self-evaluation tests, links to topics of interest related to mathematics, links to pages containing concepts of mathematics related to the subject of mathematics and for materials of secondary education.
In future we intend to implement a system of continuous evaluation based on multiple-choice tests performed on the computer. Various works of evaluation can be implemented, automatically corrected and the results exported to Excel. This is very helpful when the number of students is very high.

We wish to develop the topic of "Mathematics 0", producing materials for all the students who didn't have maths in secondary school and can overcome this deficiency with that, which is provided in the page of the MatActiva.
We will provide wsMaxima a free software, to support the resolution of exercises. The student may, in addition to using the graphical power of this software, and can also find a solution of the exercise very quickly.

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